Restriction/Election

As set forth at item 2 of the Office Action, the Examiner has imposed a restriction requirement relative to claims 13-19 added in Amendment-B and has withdrawn new claims 13-19 from consideration as allegedly being directed to a constructively non-elected, patentably distinct invention (or species) from the invention set forth in claims 1-12. It is the Examiner's position that the invention, as previously claimed and presented in the application (claims 1-12), is directed to a method generally involving a raw material such as SOG having a low dielectric constant in which the oxygen concentration is maintained at a low level during formation and processing of a coating film, but not to specific SOG materials prepared from specific reagents, while the new claims 13-19 are directed to several other species of SOG prepared from specific materials or reagents, such as alkoxides.

Applicant's Response

Upon careful consideration, applicant respectfully traverses the restriction requirement because claims 13-19 are directed to the *same invention* as set forth in independent claim 1, albeit in more narrowly defined terms (but that is the nature of dependent claims). Claims 13-19 all depend from independent claim 1, whether directly or indirectly through another claim, and present more specific definitions of the "raw material of a low dielectric constant" as defined in claim 1.

In this regard, applicant respectfully traverses the Examiner's allegation regarding the object/focus of the invention because such allegation is contradicted by the full disclosure of the specification. While the general focus of the application and the original claims relates to the processing conditions of preparing the coating film under low oxygen concentrations, the specification also presents specific examples involving specific raw materials and the preparation of same, such that the features of claims 13-19 are indisputably a part of the *same invention* as set forth in claim 1.

Additionally, applicant notes that the Examiner comments regarding the restriction alternately indicate that the claims 13-19 are directed to a patentably distinct invention and a patentably distinct specie from that of claims 1-12. In this regard, applicant also respectfully submits that claims 13-19 are not directed to a different specie of invention than claims 1-12. Again, claims 13-19 merely further define the raw material set forth in independent claim 1.

Based on the foregoing, it is respectfully requested that the restriction requirement be reconsidered and withdrawn.

Art-Based Rejections Under 35 USC §§ 102(e) and 103(a)

The Examiner continues to reject of claims 1, 2 and 9 under 35 USC '102(e) as being

anticipated by You et al. (US Patent Application Publication 2001/0029111), and to reject claims 3-8 and 10-12 under 35 USC '103(a) as being unpatentable over You et al. as applied above and further in view of Sloan (US Patent 5,431,700) and/or applicant's admitted prior art of the dual damascene method shown in Figs. 1(a) - 1(h) (AAPA) or the treatise discussion of Wolf et al. relating to silicon processing through damascene methods, presented at items 7-9 of the Office Action. The Examiner's positions regarding the rejections remains as set forth in the prior Office Action of 18 April 2002. Additionally, at item 10 of the present Office Action, the Examiner presents a Response To Arguments in which the Examiner asserts that the discussion in You's paragraph [0153], "The **combination** of step-ramp curing **and** an inert gas environment for **heating**, high temperature cure, and **cooling** steps can provide thin films with high mechanical strength and minimized oxidation, therefore leading to thin films having lower dielectric constants, such as below about 3.0 (emphasis added by the Examiner)", contradicts applicant's argument that You only uses an inert environment for the curing step and therefore does not use the inert atmosphere during the heating step to 200°C; and that that You's paragraphs [0143] - [0152] are directed to "... such heating steps which occur clearly at temperatures below 200°C. "

Applicant's Response

Upon careful consideration applicant respectfully traverses such rejection, and submits that claims 1-12 are clearly patentably distinct over the You reference and the other applied art, based on those reasons discussed in Amendment-B (i.e., You's disclosed method(s) of forming low dielectric constant coating films does not include the specific temperature-based limitations set forth in present claim 1, and such limitations are not made obvious by any other evidence of record including Sloan, AAPA and Wolf), and the following.

Initially, applicant respectfully submits that You's disclosure, when properly considered *as a whole*, does not anticipate or make obvious the specific temperature-based limitations of

claim 1 which are critical to the particularly favorable result achieved by the invention. While You's paragraph [0153], as quoted by the Examiner, briefly and generally refers to heating and cooling steps being conducted in an inert gas environment, the full disclosure of the You patent, including paragraphs [0056], [0143] - [0153] and the drawings, clearly show that You's method does not meet or suggest the conditions set forth in claim 1 that the oxygen content in the atmosphere surrounding the plate-like material be less than or equal to 1% before the surface temperature of the material rises to 200°C, and again until the surface temperature lowers to 200°C after having been heated to a temperature above 400°C.

For example, the heating steps discussed at You's paragraphs [0142] - [0153] do not occur at temperatures below 200°C, contrary to the Examiner's allegation. The lowest temperature indicated in any of these paragraphs is 250°C. Again, claim 1 requires before the surface temperature of the material rises to 200°C, the oxygen content in the atmosphere surrounding the plate-like material be less than or equal to 1%.

Moreover, according to You's complete disclosure, an inert gas environment is achieved for his various processing steps only in conjunction with processing chambers such as the deposition chambers 100a, 100b shown in his Figs. 1a, 1b (via bias gas inflow sources 124, 126), curing ovens, etc., whereas You also specifically indicates that the film is removed from the processing chambers after the various processing steps, including all of the specific discussion and examples of You's curing process. See, for example, You's paragraphs [0149] and [0151], where he explains that after a film has been cured (the curing operation including steps for cooling a film to a point where the curing is complete) it is "... removed from the curing oven and allowed to cool to room temperature." Applicant respectfully submits that the fair understanding of You's disclosure when considered as a whole is that an inert gas environment is maintained within the various processing chambers, including curing ovens where temperatures are raised and lowered in steps, whereas no such inert gas environment is maintained outside of the processing chambers, including when the films are removed from the curing ovens and allowed to cool to room temperature. When viewed in context and consistent with his full disclosure, the heating and cooling steps mentioned in You's general discussion of paragraph [0153] are simply the heating and cooling steps involved in the curing processes.

Again, the specific disclosure of paragraph [0151] indicates that a high temperature curing oven is preheated to 300°C before the wafer is placed therein, and that once the high temperature cure of the film is ramped down (cooled) to 300°C the cured wafer *is removed from the curing oven* and allowed to cool to room temperature. This indicates that the final cooling of the wafer from 300°C to room temperature is not performed in the inert gas environment, contrary to the requirements of claim 1 that the oxygen content in the atmosphere surrounding the plate-like material be less than or equal to 1% until the surface temperature lowers to 200°C after having been heated to a temperature above 400°C.

Applicant respectfully submits that the above distinctions are very significant because the present invention achieves significant advantage over conventional processes not only in terms of low dielectric constants of the cured coating film, but also a significantly smaller degree of film thickness reduction (shrinkage). In this regard, applicant encloses herewith a chart and an associated graph showing Film Shrinkage Data of Low O_2 Bake Plate, where the results of film thickness reduction (shrinkage) in the cases where the oxygen concentration was set at 20.80%, 10.00%, 1.00%, 1000ppm and 100ppm, respectively, while the treatment time and temperature was kept the same. As indicated by the data, the difference between the initial film thickness and the baked film thickness can be reduced to an acceptable level in the case where the oxygen concentration was 1.00% or less, which is a primary aspect of claim 1. On the other hand, the Lu reference does not meet the limitations of claim 1 as discussed above, and does not otherwise address or appreciate the significant advantage of less film shrinkage as achieved by the present invention.

Based on the foregoing, applicant respectfully submits that the rejections of claims 1-12 under 35 USC '102(e) and 103(a) are overcome, and accordingly it is respectfully requested that such rejections be reconsidered and withdrawn.

Conclusion

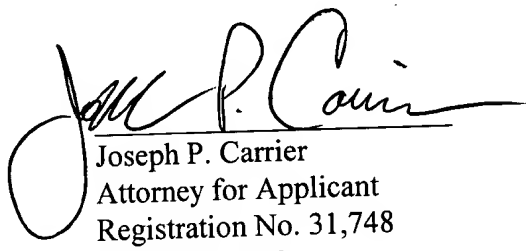
In conclusion, applicant: respectfully request reconsideration of the restriction requirement; has overcome the Examiner's rejections set forth in the final Office Action, and

moreover, applicant respectfully submits that the application is now in condition for allowance, and a notice to that effect is earnestly solicited.

Favorable reconsideration is respectfully requested.

A Petition For Three-Month Extension is being filed concurrently herewith.

Respectfully submitted,



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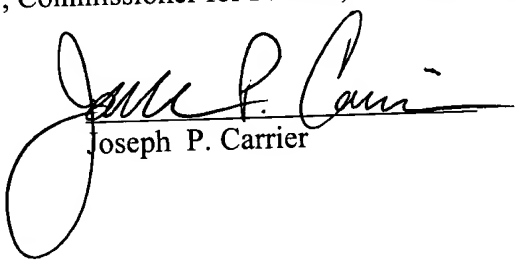

Joseph P. Carrier

JPC/ms
enclosures

→ claimed range

	20.80%			10.00%			1.00%			1000ppm			100ppm		
	Initial	after H/B	Diff.	Initial	after H/B	Diff.	Initial	after H/B	Diff.	Initial	after H/B	Diff.	Initial	after H/B	Diff.
1	4176.3	3958.8	217.5	4303.7	4132.5	171.2	4250	4159.2	90.8	4182.2	4093.6	88.6	4187.7	4130.3	57.4
2	4089.7	3865.2	224.5	4089.1	3906.7	182.4	4014.7	3961.7	53	4062.3	3988.6	73.7	4057.2	3979.7	77.5
3	4161	3966.8	194.2	4200.5	4047.2	153.3	4179.7	3993.7	186	4156.7	4088.3	68.4	4199.2	4050.2	149
4	4166.3	3954.5	211.8	4159.7	4044.3	115.4	4128	4025.5	102.5	4135.2	4050.8	84.4	4122.2	4061.7	60.5
5	4169.7	3959.6	210.1	4155.5	4033.5	122	4142.2	4019.7	122.5	4125	4066.7	58.3	4129.5	4035.7	93.8
6	4177	3956	221	4239.3	4051.6	187.7	4123.7	4040.7	83	4148.2	4068.2	80	4148.2	4071.7	76.5
7	4132.5	3953	179.5	4186.5	4012.5	174	4128	4055.2	72.8	4150.5	4037.7	112.8	4177.8	4077.7	10[redacted]
8	4020.5	3825.7	194.8	4017.6	3884.7	132.9	3965.3	3876	89.3	3999.5	3927.6	71.9	3912.5	3891.2	21[redacted]
9	3923.3	3732.2	191.1	4068.7	3929.1	139.6	3977.7	3881.1	96.6	3957.3	3881.1	76.2	3896.5	3837.5	59
	4112.9	3908.0	[redacted]	4157.8	4004.7	[redacted]	4101.0	4001.4	[redacted]	4101.9	4022.5	[redacted]	4092.3	4015.1	[redacted]
			204.9			153.2			99.6			79.4			77.2

	B	R	A	%
20.8%	4112.922	204.9444	3907.978	4.98
10.0%	4157.844	153.1667	4004.678	3.68
1.0%	4101.033	99.61111	4001.422	2.43
1000ppm	4101.878	79.36667	4022.511	1.93
100ppm	4092.311	77.23333	4015.078	1.89

	Shrinkage	Filmthickness
80%	4.98	204.9444
00%	3.68	153.1667
00%	2.43	99.61111
om	1.93	79.36667
m	1.89	77.23333